

DISTINCTIVE MIDDLE CAMBRIAN SPONGE-CALCIMICROBE REEFS IN IRAN.

Memoirs of the Queensland Museum 44: 298. 1999:- Following the virtual demise of archaeocyaths in the Toyonian stage and consequent collapse of the Early Cambrian archaeocyath-calcimicrobe reef consortium, Middle and Late Cambrian reefs remained generally devoid of metazoan input, being almost entirely microbial. The few exceptions in this interval generally include some minor contribution by spiculate sponges. One such spiculate sponge-calcimicrobe reef system in the Middle Cambrian of northern Iran is distinctive in that the spiculate sponges constitute a major component of the reef framework.

The reefs are in units 2 and 3 of the Mila Formation in the eastern Elburz (Alborz) Mountains. The Mila Formation consists of five units, together ranging in age from Middle Cambrian to Early Ordovician. Trilobites permit correlation of unit 2 and the reef-bearing lower unit 3 with the late Middle Cambrian, and upper unit 3 with the Chinese Kushanian (terminal Middle to earliest Late Cambrian) and Changshanian (Late Cambrian) stages. The reefs are well exposed in a road section 3 km north of Shahmirzad. The reefs are constructed by a consortium of the anthaspidellid sponge *Rankenella* and a presumed variety of microbes including the calcimicrobe *Girvanella*. *Rankenella* is otherwise known only from the Ordian-early Templetonian stage of the Northern Territory, Australia. That stage is equivalent respectively to the late Toyonian-early Amgan and Longwangmiaoan-Maozhuangian stages of Siberia and China. Unit 2 comprises fossiliferous interbeds of grey limestone/dolostone and yellow-brown marly shale, with desiccation cracks, bidirectional ripples and probable tempestites and hardgrounds.

The stratigraphically lowest known appearance of *Rankenella* is in upper unit 2, in a single

decimetre-thick limestone bed of abundant eocrinoid ossicles. Scattered, widely conical *Rankenella* are preserved upright in life position, suggesting attachment to a hardground. Sponges, ossicles, trilobites and hyoliths are encrusted by *Girvanella*, which also forms rafts and onkoids. Texture within this biostromal bed ranges from floatstone-rudstone to *Girvanella* boundstone, with evidence of microbial and oxea-bearing sponge-body automicrites. The lower, reef-bearing portion of overlying unit 3 is massive, comprising pale grey stacked bioherms of similar texture and composition to the unit 2 *Rankenella* bed. In this interval, *Rankenella* adopts the entire range of co-occurring cup shapes from narrowly conical through to explanate. Clotted-peloidal biohermal mud is interpreted as automicrite. Substrate, peribiohermal and overlying sediment is commonly a bioclast rudstone rich in orthide brachiopod valves. Sponges are contributors to bioconstruction in a reef tract toward the top of lower unit 3. Component bioherms of this reef tract are constructed by ramose *Rankenella* encrusted by thick coatings of *Girvanella* to form a *Rankenella-Girvanella* framestone with only minor lime mud pockets. Interstices are rimmed by one to two generations of columnar cement and occluded by coarse equant cement. By comparison with Early Cambrian reefs, *Rankenella* and *Girvanella* played the roles of archaeocyaths and calcimicrobes: framework/substrate and encrusting/binding respectively. In many Early Cambrian reefs, however, lime mud represents a much greater component, while calcimicrobes were capable of building massive framework unaided by metazoans. □ *Porifera, Middle Cambrian, Iran, calcimicrobe, Rankenella, Girvanella, reef, automicrite.*

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